Exploring efficient modeling network data structure, flow and organization

Presented to
MTF

Presented by
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July 30th, 2019

Problem statement

- Different models in overlapping geographic areas use different network representation of the same physical network
- We have FSUTMS standards, but we lack a standard/common network
- Difficult to share common input data elements
  - FTYPE, ATYPE, Number of Lanes, Speed, Volume, etc.
- Difficult to exchange information among models of multi-scales and multi-resolutions
- Difficult to view and compare future projections

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Research Objectives

- Explore viable solutions for improving model network structures for more efficient travel demand forecasting.
  - Better information sharing
  - Improved accuracy
  - Remove redundancy in data collection and processing
- Explore the ways to facilitate access of different data sources
- Provide recommendations and solutions for implementation

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Multi-scale and multi-resolution

Multi-scale network

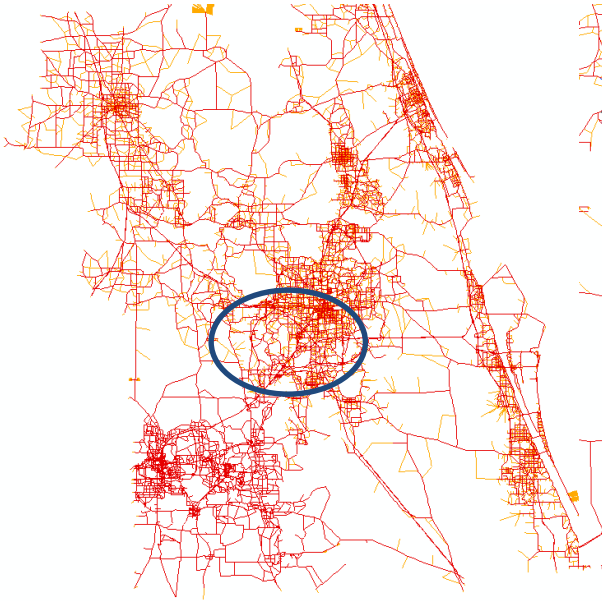
State Level

State & Regional

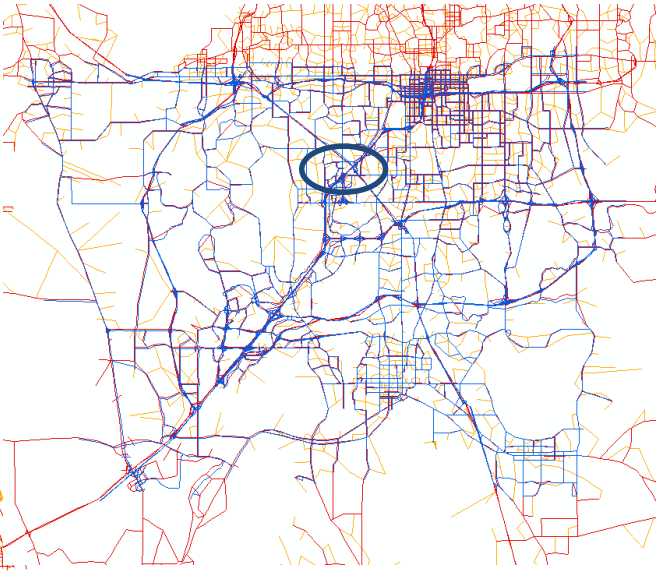
State , Regional & Local

Multi-resolution network

Macroscopic



Mesoscopic



Microscopic

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Consideration for Network Requirements

Network Structure

- Node-link data structure
- Integrated easily with ArcGIS and compatible with modeling software
- Maintain required variables for modeling

Data Source

- A reliable source such as FDOT RCI, ARBM, HERE...
- Criteria for choosing the source if multiple sources

Data Management

- Different scales of data (state/regional/local)
- Shared among different agencies and stakeholders (safety, operation, transit, forecasting & trends, civil integrated management office in FDOT)
- Clearly defined portion of data (links and attributes) that could be shared

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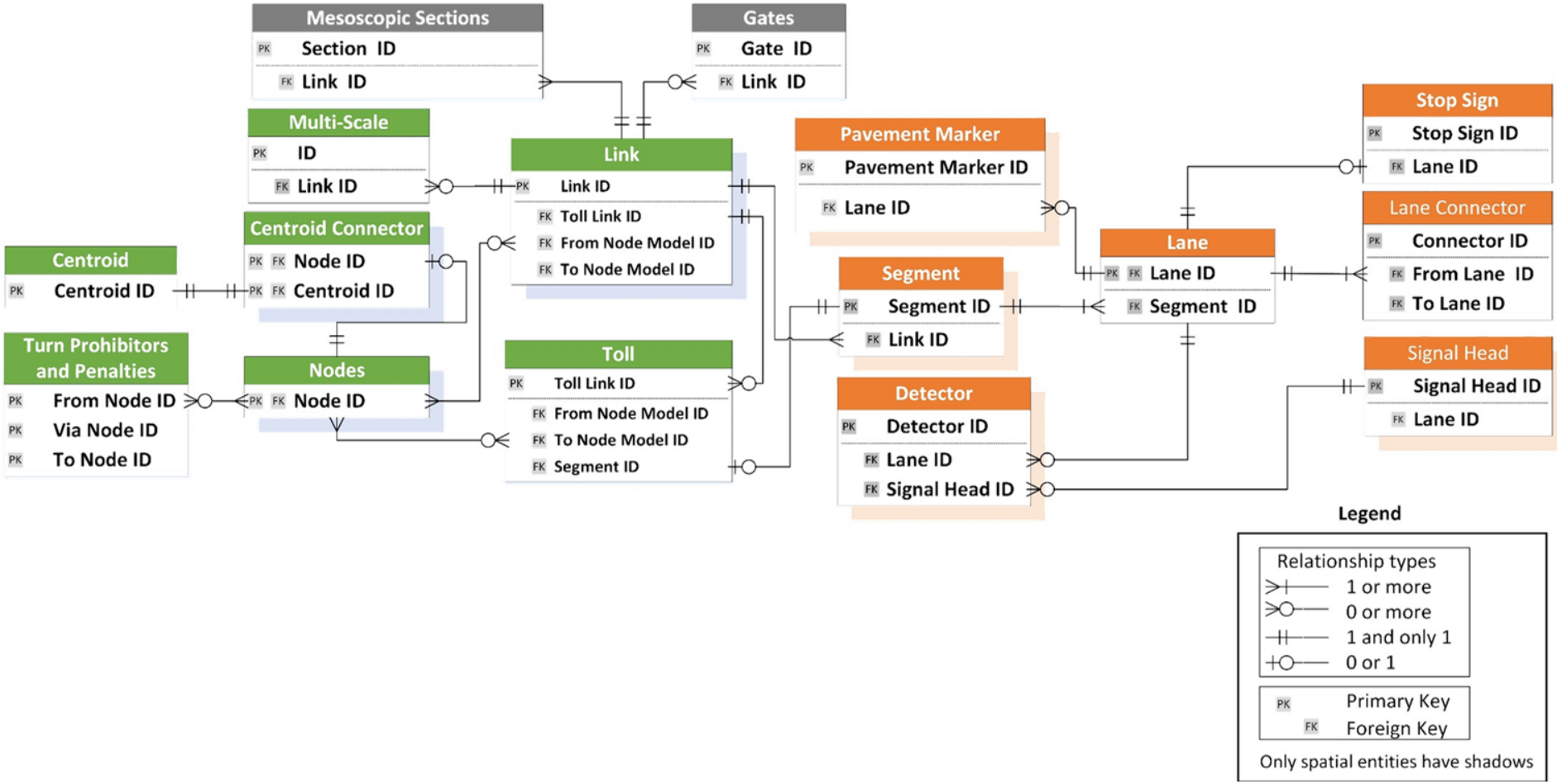
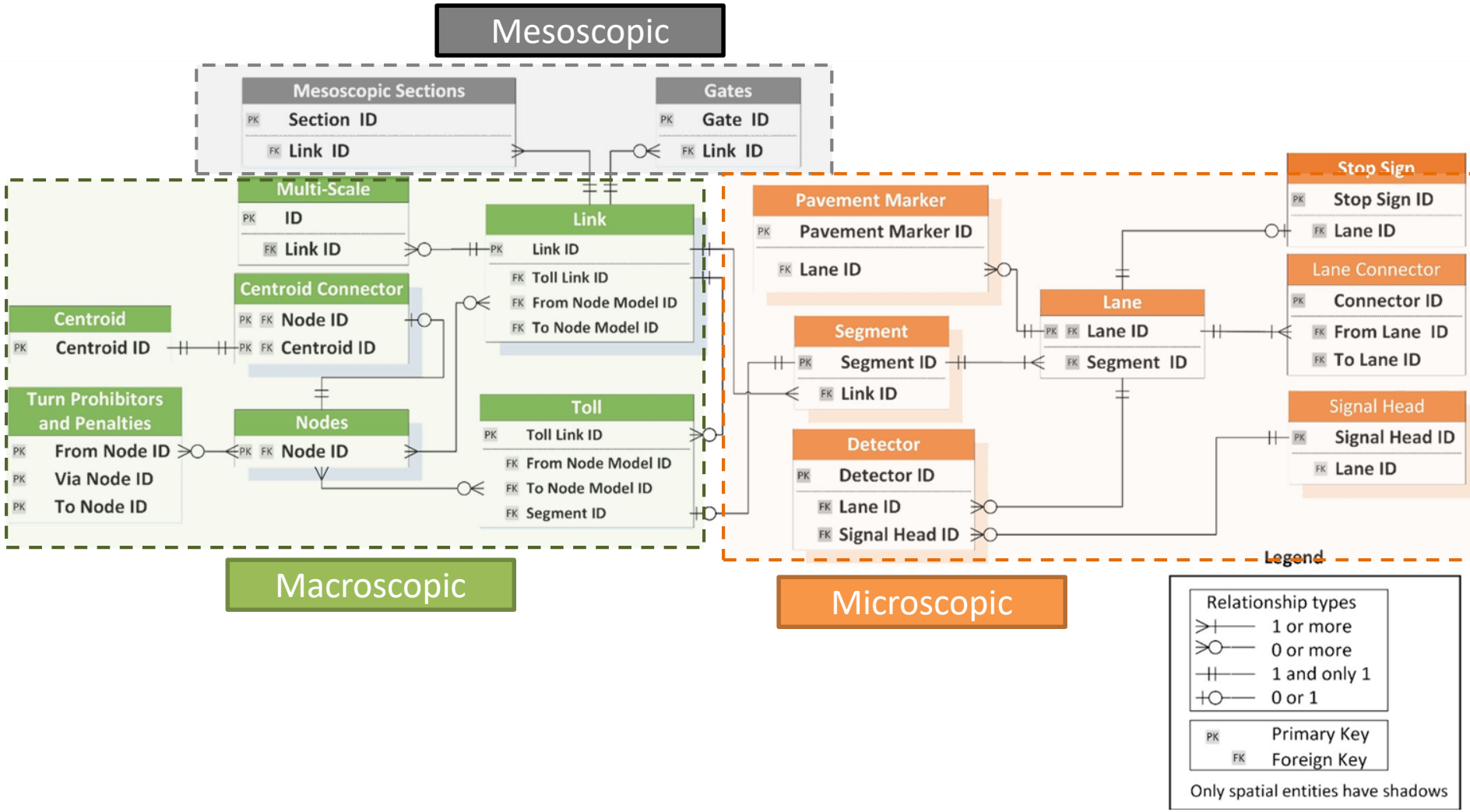
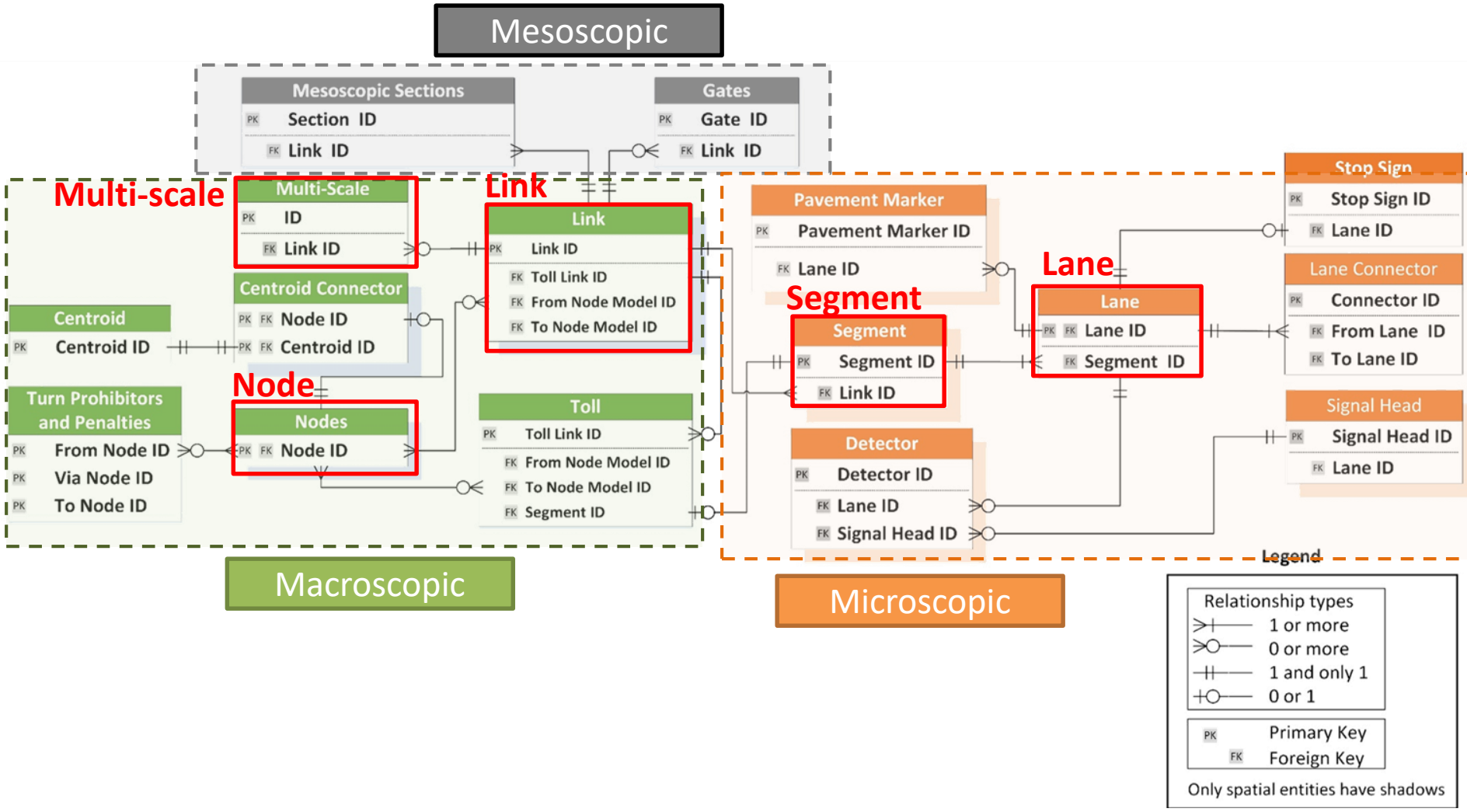
Multi-scale / Multi-resolution Data Structure



Multi-scale / Multi-resolution Data Structure

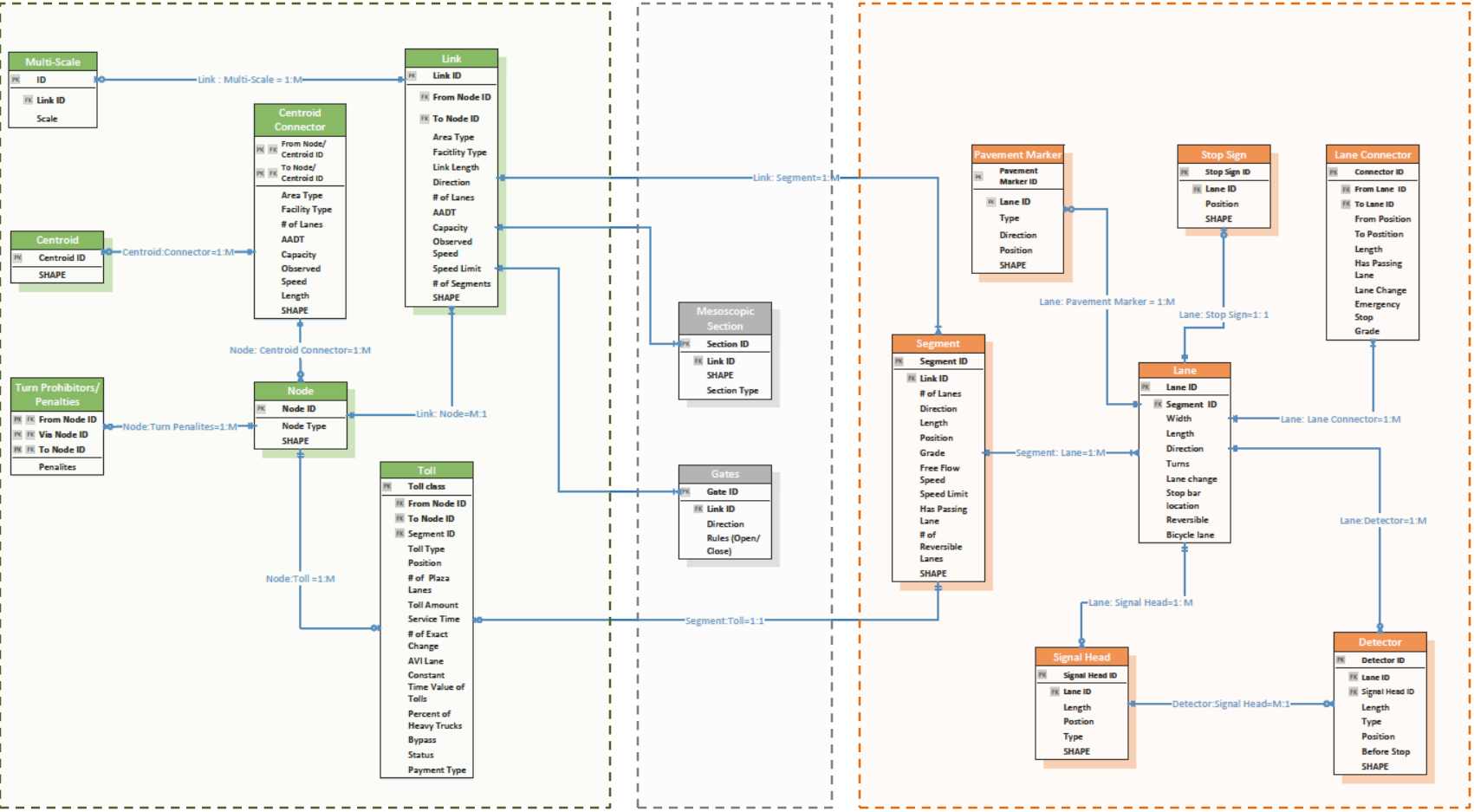


Multi-scale / Multi-resolution Data Structure



Multi-scale / Multi-resolution Data Structure

Macroscopic | Mesoscopic | Microscopic



Legend

Relationship types

- 1 or more
- 0 or more
- 1 and only 1
- 0 or 1

- Primary Key
- Foreign Key

Only spatial entities have shadows

Definition

Multi-Scale is the involvement of links in the travel demand models of different geographical scales such as statewide scale, regional scale and local scale.

Multi-Resolution is the integration of macroscopic, mesoscopic and microscopic models for the purpose of enabling data to be shared across modeling platforms for transportation projects at different levels of detail.

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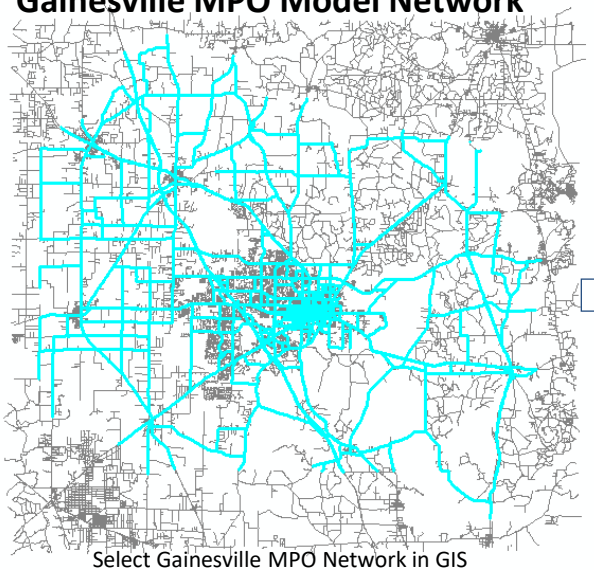
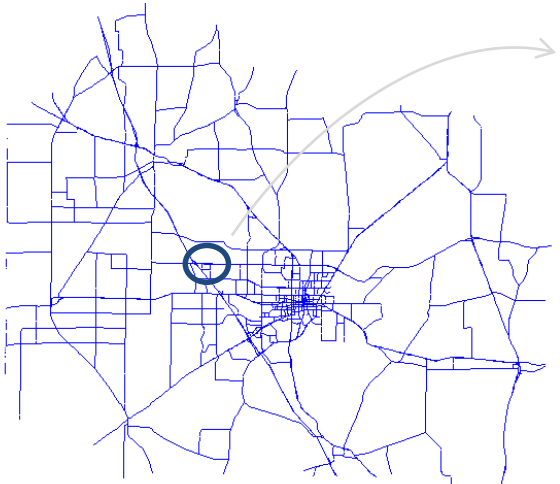
Multi-scale Network - Links

Gainesville MPO Model Network



Select Gainesville MPO Network in GIS



Import Gainesville MPO Network into Modeling Software (Cube)

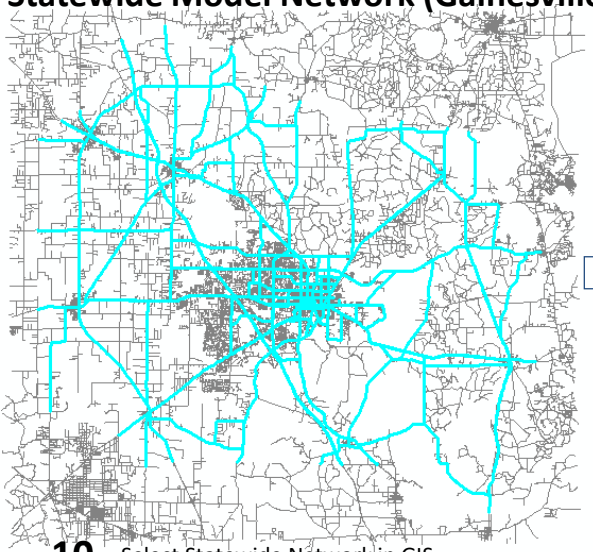
Link Attribute (GIS)

LINK_ID	SW_Scale	GN_Scale	Lane	...
105818169	Y	Y	3	...
105818170	Y	Y	3	
106100015		Y	1	
106100015		Y	2	
984529649	Y	Y	3	
984529651	Y	Y	3	
984529820		Y	1	
984529820		Y	2	
...				

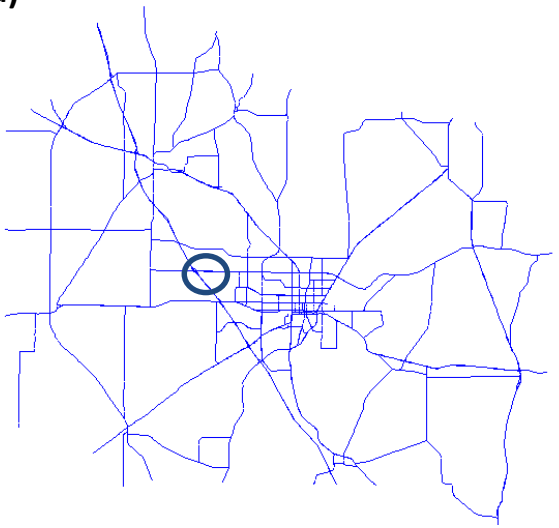
Links in the statewide model

Links in the Gainesville model

Statewide Model Network (Gainesville Area)



Select Statewide Network in GIS



Import Statewide Network into Modeling Software (Cube)

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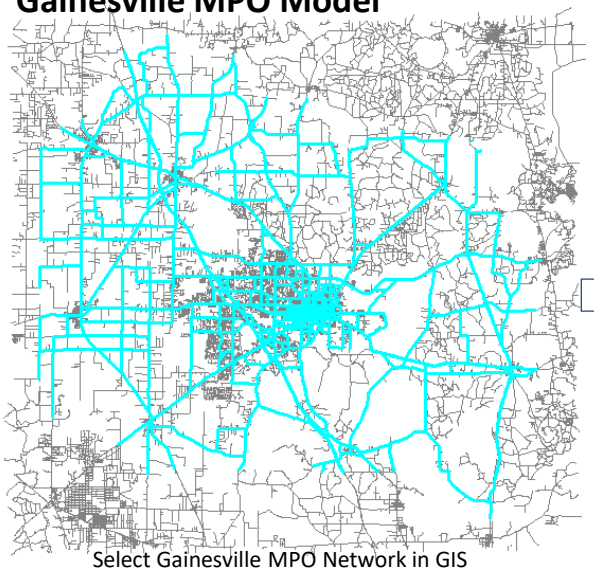
Multi-scale Network - Nodes

Gainesville MPO Model



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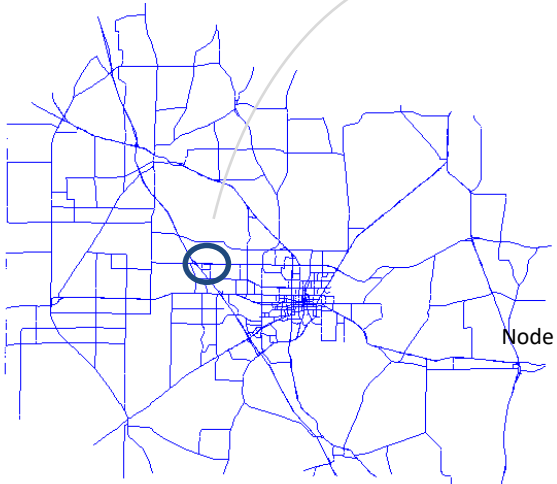


Import Gainesville MPO Network into Modeling Software (Cube)

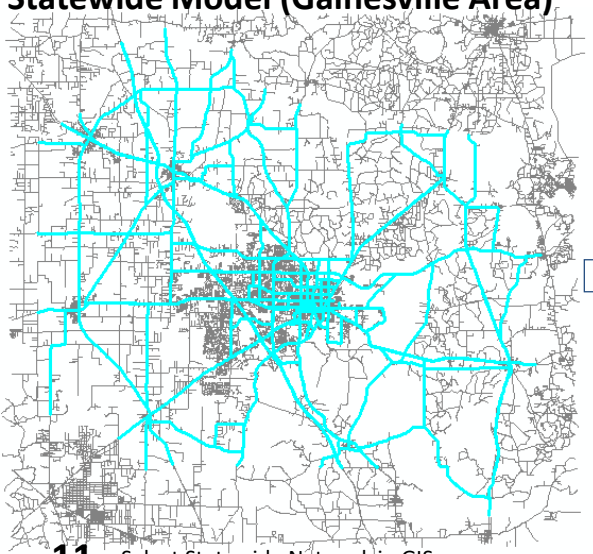
Link Attribute (Cube)

OID	LINK_ID	A	B	Lane	...
1	105818169	1007	1002	3	...
2	105818170	1001	1006	3	
3	106100015	1002	1001	1	
4	106100015	1001	1002	2	
5	984529649	1003	1001	3	
6	984529651	1002	1004	3	
7	984529820	1001	1005	1	
8	984529820	1005	1001	2	
...					

Node table

AB_Node	Common_Node
1001	207501172
1002	207501173
1003	997669556
1004	997669557
1005	997669672
1006	42933946
1007	42933947
...	

Statewide Model (Gainesville Area)



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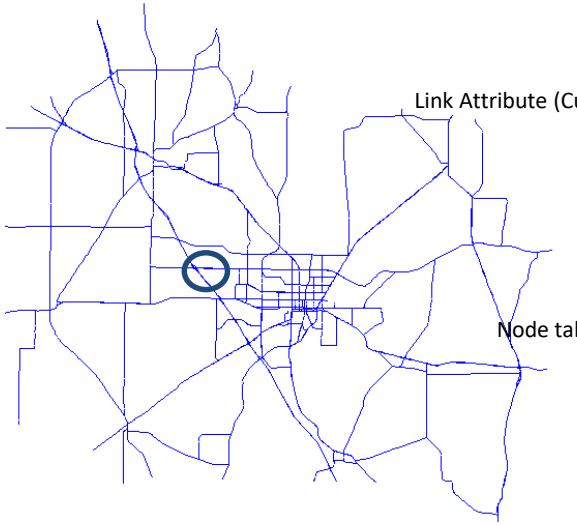

Import Statewide Network into Modeling Software (Cube)

Link Attribute (Cube)

OID	LINK_ID	A	B	Lane	...
1	105818169	2005	2003	3	...
2	105818170	2004	2006	3	
3	984529649	2002	2004	3	
4	984529651	2003	2001	3	
...					

Node table

AB_Node	Common_Node
2001	997669557
2002	997669556
2003	207501173
2004	207501172
2005	42933947
2006	42933946
...	

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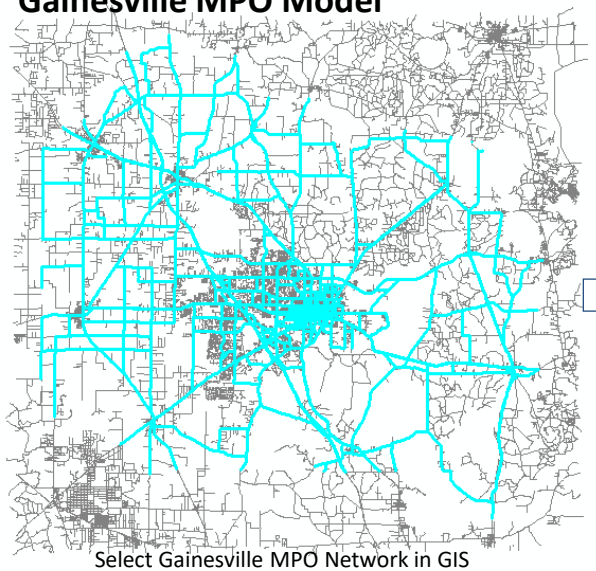
Multi-scale Network - Nodes

Gainesville MPO Model



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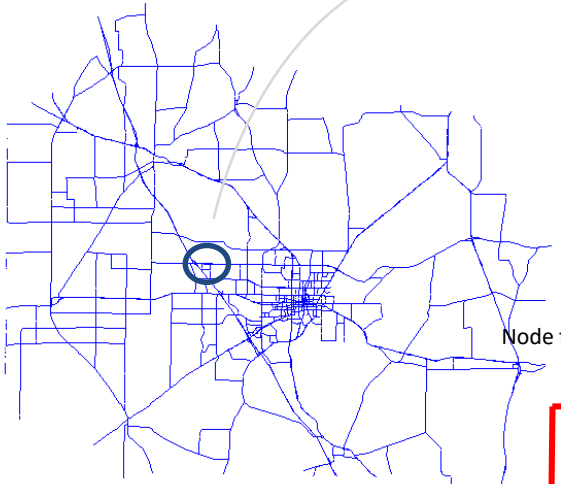

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Link Attribute (Cube)

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3	106100015	1002	1001	1	
4	106100015	1001	1002	2	
5	984529649	1003	1001	3	
6	984529651	1002	1004	3	
7	984529820	1001	1005	1	
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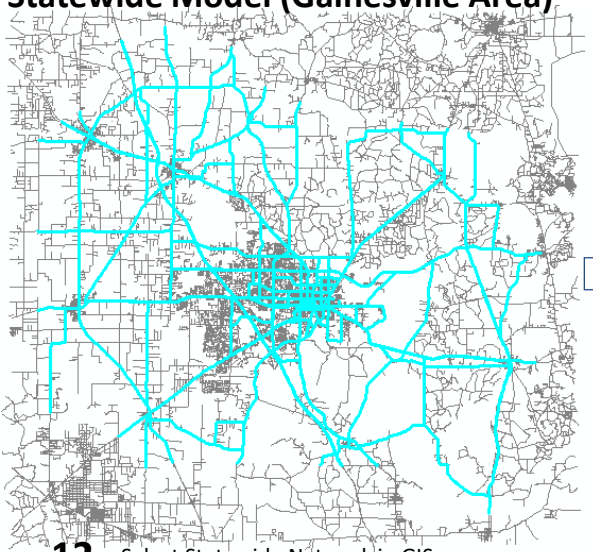
Statewide Model (Gainesville Area)



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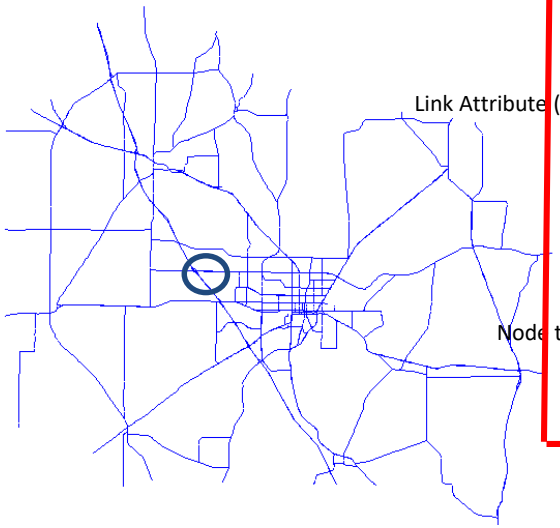

Import Statewide Network into Modeling Software (Cube)

Link Attribute (Cube)

OID	LINK_ID	A	B	Lane	...
1	105818169	2005	2003	3	...
2	105818170	2004	2006	3	
3	984529649	2002	2004	3	
4	984529651	2003	2001	3	
...					

Node table

AB_Node	Common_Node
2001	997669557
2002	997669556
2003	207501173
2004	207501172
2005	42933947
2006	42933946
...	

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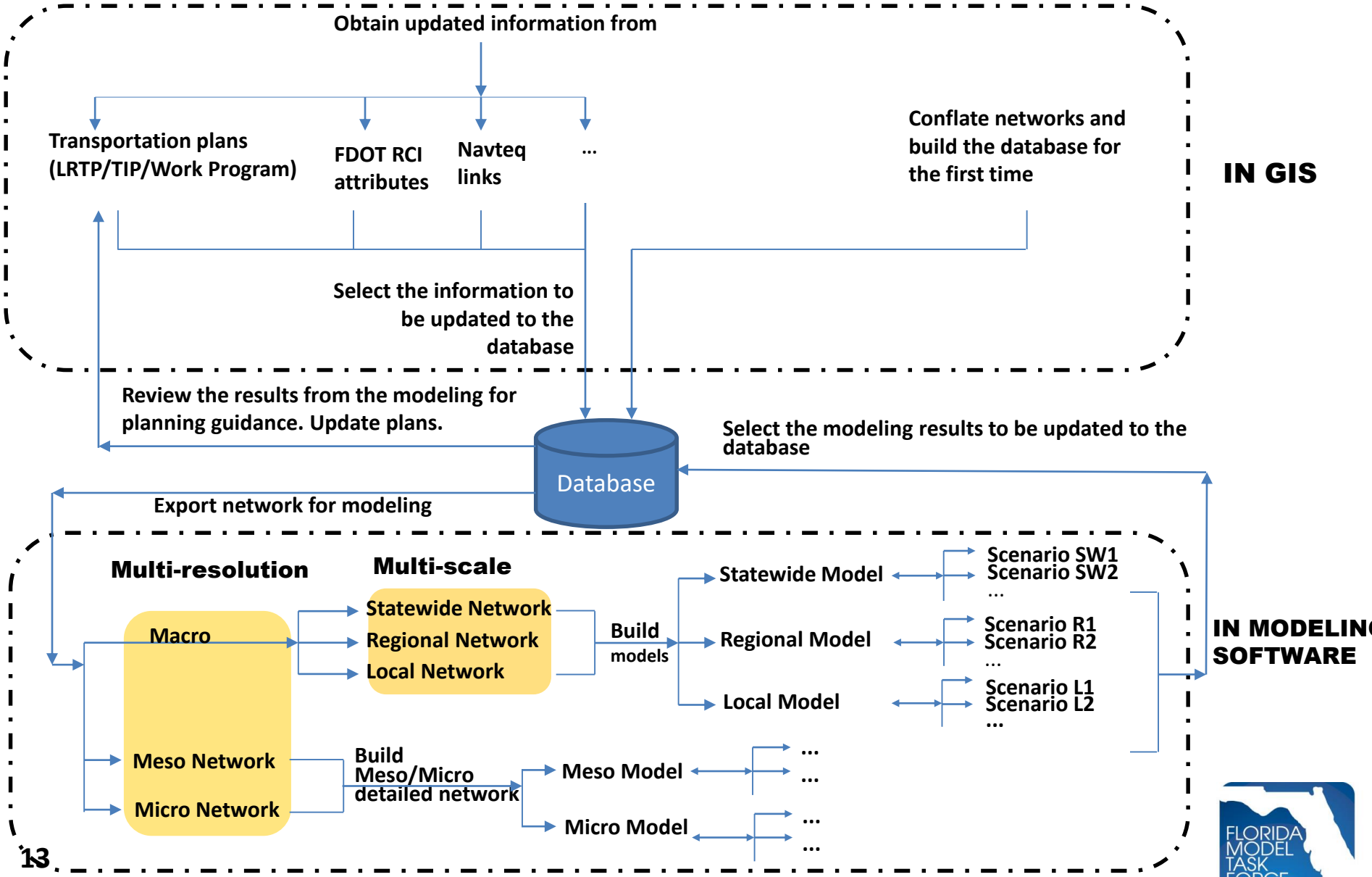
Network Database Data Flow



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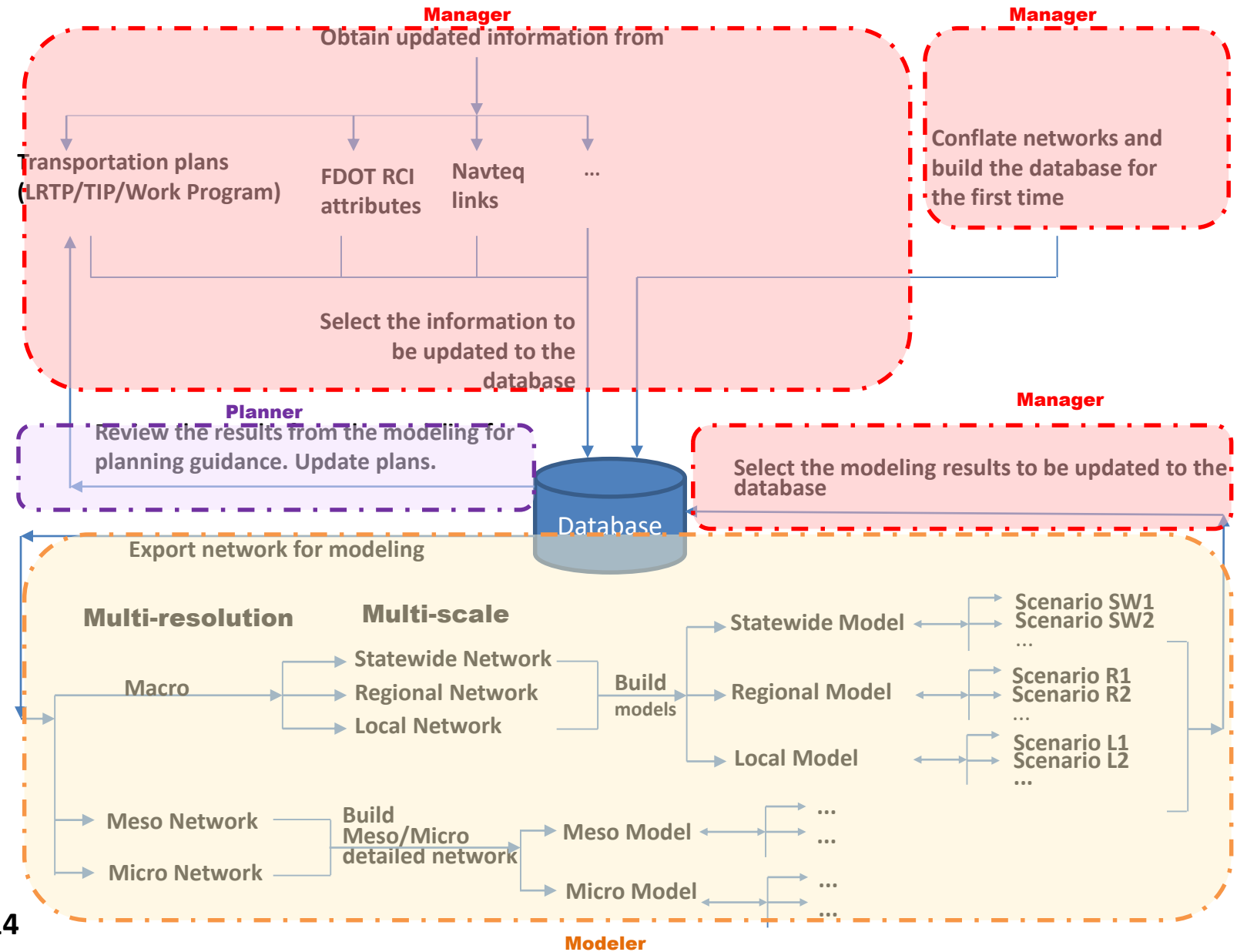
Network Database Management Roles



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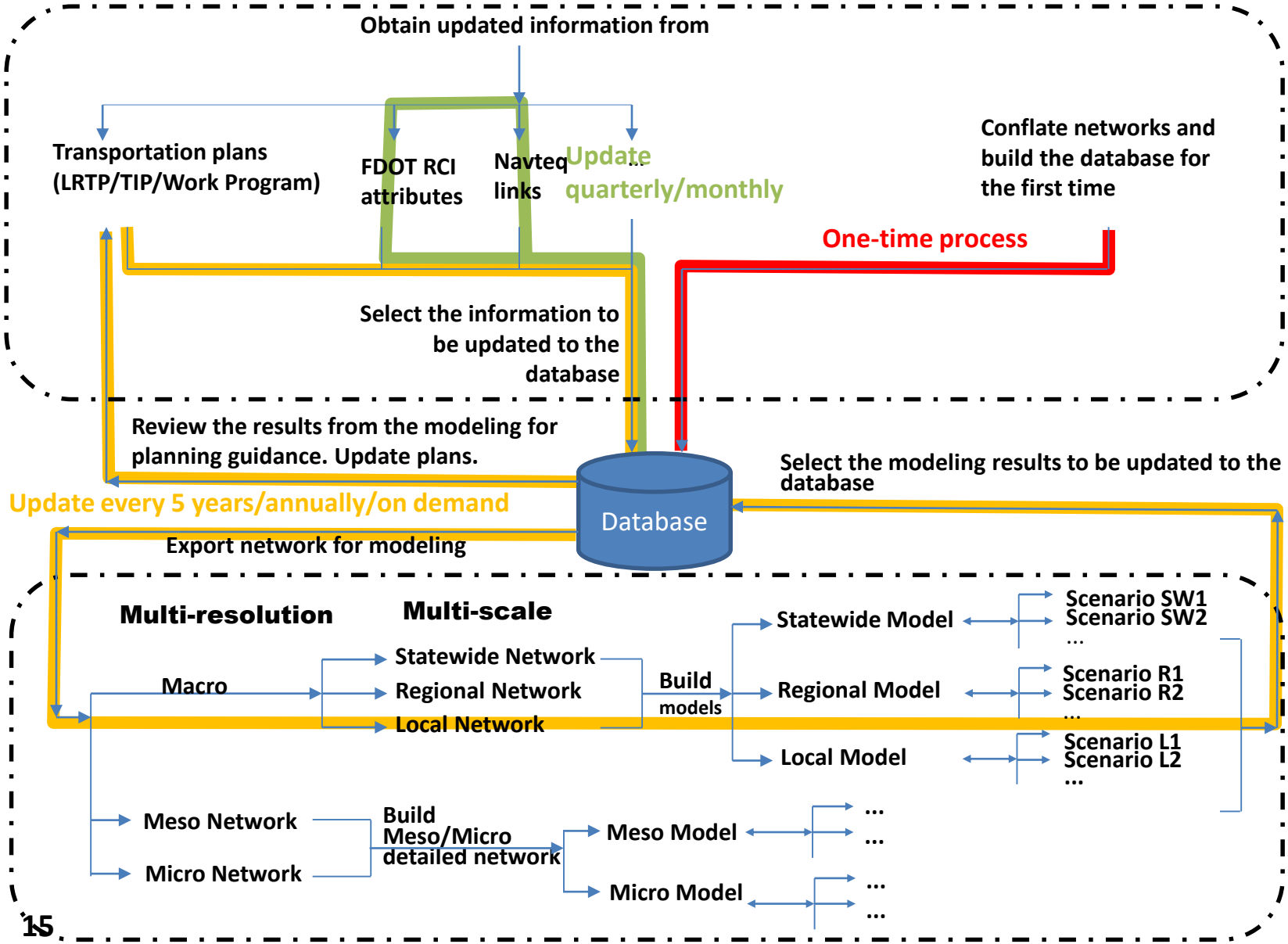
Network Database Update Cycle



IN GIS

IN MODELING SOFTWARE

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Support for Planning Stages

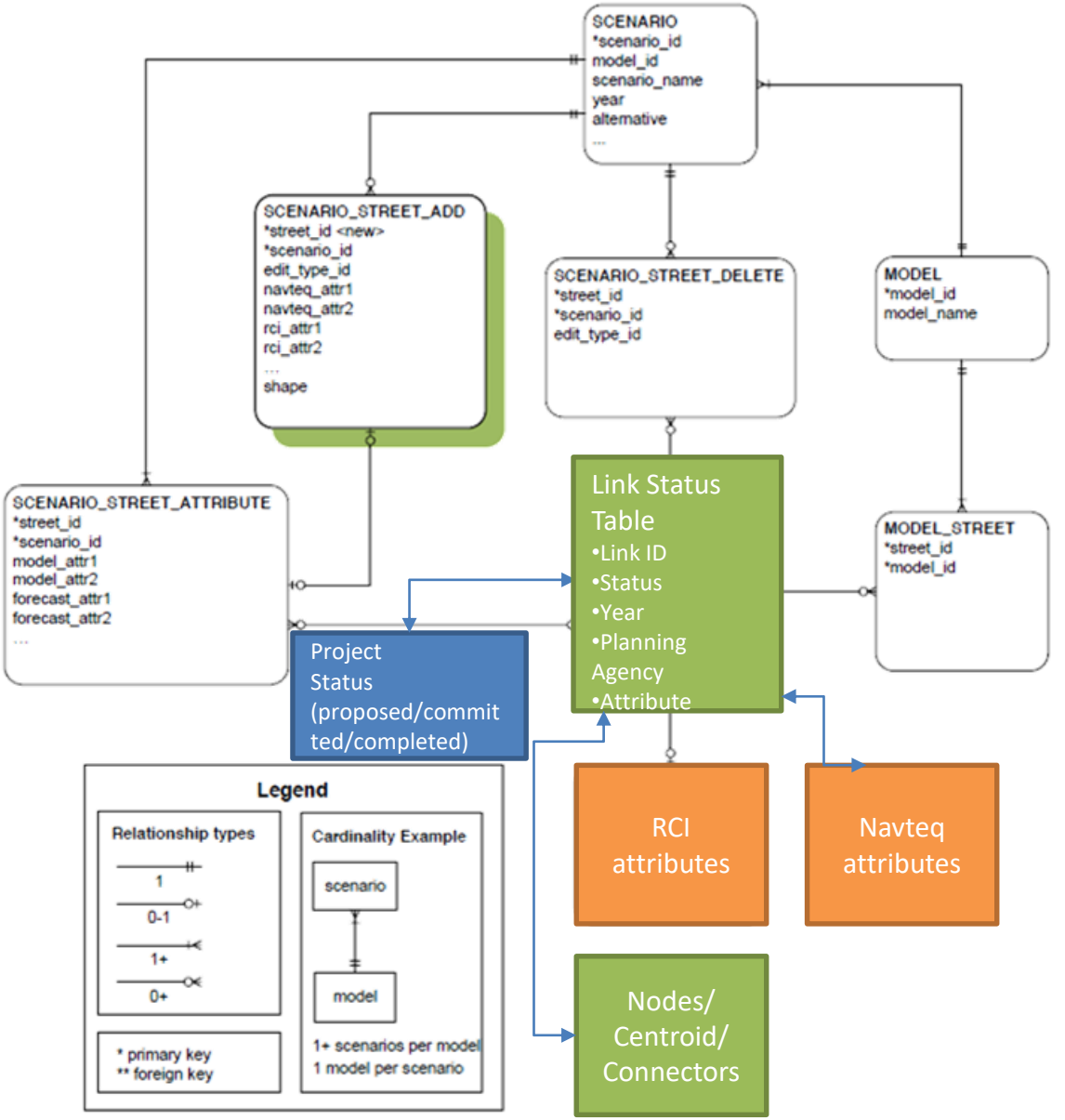

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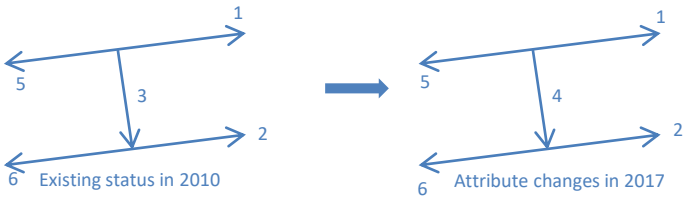
Illustration Planning Stage Update



Attribute Change

Link Attribute Table

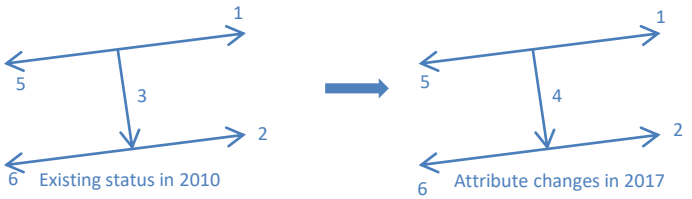
Link ID	Link Status	Year	Agency	Planning stage	# of lanes	Project ID	Action
1	Existing	2010					
2	Existing	2010					
3	**Existing**	**2010**			**2**		

Project Table

OID	Project ID	Link ID	Name	Status	Action
1	1	3	Gainesville LRTP 2015	Needs Plan to delete	Delete
2	1	3	Gainesville LRTP 2015	Committed (delete)	Delete
3	1	4	Gainesville LRTP 2015	Needs Plan to add	Add
4	1	4	Gainesville LRTP 2015	Committed (add)	Add

FLORIDA MODEL TASK FORCE

Illustration Planning Stage Update



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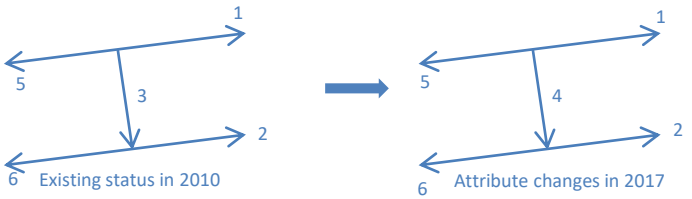
1	Existing	2010					
2	Existing	2010					
3	Existing	2010			2		
3	Needs Plan to delete	2014	Gainesville MPO	Needs plan		**1**	**Delete**
3	Committed (delete)	2015	Gainesville MPO	LRTP 2015		**1**	**Delete**

Project Table

OID	Project ID	Link ID	Name	Status	Action
1	**1**	**3**	Gainesville LRTP 2015	Needs Plan to delete	**Delete**
2	**1**	**3**	Gainesville LRTP 2015	Committed (delete)	**Delete**
3	1	4	Gainesville LRTP 2015	Needs Plan to add	Add
4	1	4	Gainesville LRTP 2015	Committed (add)	Add

FLORIDA MODEL TASK FORCE

Illustration Planning Stage Update



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1	Existing	2010					
2	Existing	2010					
3	Existing	2010			2		
3	Needs Plan to delete	2014	Gainesville MPO	Needs plan		1	Delete
3	Committed (delete)	2015	Gainesville MPO	LRTP 2015		1	Delete
4	Needs Plan to add	2014	Gainesville MPO	Needs plan	**3**	**1**	**Add**
4	Committed (add)	2015	Gainesville MPO	LRTP 2015	**3**	**1**	**Add**
5	Existing	2010					
6	Existing	2010					

Project Table

OID	Project ID	Link ID	Name	Status	Action
1	1	3	Gainesville LRTP 2015	Needs Plan to delete	Delete
2	1	3	Gainesville LRTP 2015	Committed (delete)	Delete
3	**1**	**4**	Gainesville LRTP 2015	Needs Plan to add	**Add**
4	**1**	**4**	Gainesville LRTP 2015	Committed (add)	**Add**

In the year of 2015 after 2015 LRTP being committed, Link Attribute Table & Project Table get updated.

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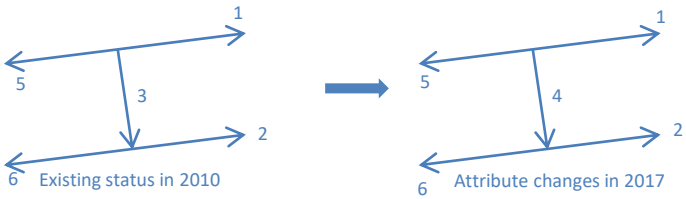
Illustration Planning Stage Update



After the construction of change is complete, Link Attribute Table, Project Table get updated.

Link Attribute Table

Link ID	Link Status	Year	Agency	Planning stage	# of lanes	Project ID	Action
1	Existing	2010					
2	Existing	2010					
3	Existing	2010			2		
3	Needs Plan to delete	2014	Gainesville MPO	Needs plan		1	Delete
3	Committed (delete)	2015	Gainesville MPO	LRTP 2015		1	Delete
3	**Deleted**	**2017**				**1**	**Complete**
4	Needs Plan to add	2014	Gainesville MPO	Needs plan	3	1	Add
4	Committed (add)	2015	Gainesville MPO	LRTP 2015	3	1	Add
4	**Existing**	**2017**			**3**	**1**	**Complete**
5	Existing	2010					
6	Existing	2010					

Project Table

OID	Project ID	Link ID	Name	Status	Action
1	1	3	Gainesville LRTP 2015	Needs Plan to delete	Delete
2	1	3	Gainesville LRTP 2015	Committed (delete)	Delete
3	1	4	Gainesville LRTP 2015	Needs Plan to add	Add
4	1	4	Gainesville LRTP 2015	Committed (add)	Add
5	**1**	**3**	Gainesville LRTP 2015	Deleted	**Complete**
6	**1**	**4**	Gainesville LRTP 2015	Existing	**Complete**

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Next steps

- Explore the feasibility of the solution to support the needs of multi-scale and multi-resolution modeling for different agencies and stakeholders
  - Meetings with RCI, CIM, Safety Office to discuss the data sources and roles
- Proof of concept using the Gainesville model and the statewide model with the network database structure
- Provide concrete recommendations for practical implementation of the proposed network database

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Questions / Comments ?

Contact:

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Vladimir Majano, Vladimir.Majano@dot.state.fl.us